[0098] FIG. **3** shows a first video data (VD**1**) including a transformed coefficient (TC), and FIG. **4** shows a second video data (VD**2**) including a first quantized coefficient (QC**1**). As is illustrated in FIGS. **3** and **4**, a transformed coefficient (TC) and a quantized coefficient (QC) may each include several coefficient units.

[0099] For example, the transformed coefficient (TC) of FIG. **3** may include coefficient units a**1**-a**4**, b**1**-b**4**, c**1**-c**4**, and d**1**-d**4**, and the first quantized coefficient (QC**1**) of FIG. **4** may include coefficient units a**11**-a**41**, b**11**-b**41**, c**11**-c**41**, and d**11**-d**41**.

[0100] The quantized coefficient arranging unit **103***c* receives the first quantized coefficient (QC**1**) to one-dimensionally arrange the coefficient units of the first quantized coefficient (QC**1**) according to a predetermined or, alternatively, desired rule. In the data encoding apparatus **100**, for example, the coefficient units of the first quantized coefficient (QC**1**) may be arranged one-dimensionally in a zigzag scan manner. As shown in FIG. **5**, the coefficient units of the first quantized coefficient (QC**1**) may be arranged one-dimensionally in the order shown in FIG. **4**. In this case, it is assumed that the level value of coefficient unit b**41** is the final quantized coefficient unit, which is not 0, the level value of coefficient unit b**31** is not 0 and is a quantized coefficient unit nearest to coefficient unit b**41**. Further, it is assumed that all of the quantized coefficient units between b**31** and b**41** are 0.

[0101] In this case, the second rounding offset value (RO**2**) may be determined again by applying b**41** to the following Equation 8 and the above Equation 7.

$$k=3+d/2 \qquad \text{[Equation 8]}$$

[0102] Here, d is the distance between coefficient unit b**31** and b**41**, and d=7 is shown in FIG. **4**. The determination of the second rounding offset value (RO**2**) may be performed by receiving the first quantized coefficient (QC**1**) one-dimensionally arranged in the rounding offset determining unit **103***b*.

[0103] The quantized coefficient determining unit **103***a* may create and output the second quantized coefficient (QC**2**) by receiving the second rounding offset value (RO**2**) from the rounding offset determining unit **103***b* and applying this second rounding offset value (RO**2**) to the transformed coefficient (TC).

[0104] If these procedures are repeated, the level value of data transformed into a frequency domain in a high-frequency area may be transformed to 0, and an output bit stream (BS), the number of bits thereof having been reduced, may be created. That is, the capacity of data is reduced after image compression, so as to reduce the amount of data transmitted to a decoding apparatus.

[0105] FIG. **7** is a block diagram schematically showing a part of a data encoding apparatus according to at least one example embodiment of the inventive concepts.

[0106] Referring to FIG. **7**, an apparatus **130** for encoding data includes a transform unit **120**, an input unit **121**, and a quantization unit **122**, each of which may be embodied as circuits or circuitry, one or more processors executing computer-readable code, or a combination of circuits or circuitry and one or more processors executing computer-readable code.

[0107] The transform unit **120** receives a macroblock data (MBD), and transforms the picture data of the spatial area into the picture data of the frequency area. In this case, the macroblock data (MBD) may be a residual block obtained by subtracting a predicative picture from the original picture.

[0108] The transform unit **120** performs the spatial transform of the residual block to create a first transformed coefficient (TC**1**). As the spatial transform, discrete cosine transform (DCT), wavelet transform, or the like may be used.

[0109] The input unit **121** serves to receive the first transformed coefficient (TC**1**) of a macroblock unit and transmit this first transformed coefficient (TC**1**) to the quantization unit **122**. The input unit **121** may include a physical circuit formed separately with respect to the quantization unit **122**.

[0110] The quantization unit **122** receives the first transformed coefficient (TC**1**), and quantizes this first transformed coefficient (TC**1**) to create a first quantized coefficient (QC**1**) and output the first quantized coefficient (QC**1**). The first quantized coefficient (QC**1**) is provided to another circuit (for example, another quantization unit or rounding offset determining unit) to be used to perform the aforementioned process of determining a rounding offset value and the aforementioned process of determining a quantized coefficient.

[0111] FIG. **8** is a block diagram showing the detailed module of a quantization unit of a data encoding apparatus according to at least one example embodiment of the inventive concepts.

[0112] Referring to FIG. **8**, a quantization unit **160** includes a quantized coefficient determining unit **161**, a rounding offset determining unit **162**, and a quantized coefficient arranging unit **163**, each of which may be embodied as circuits or circuitry, one or more processors executing computer-readable code, or a combination of circuits or circuitry and one or more processors executing computer-readable code. The quantization unit **160** also includes an internal memory **164**. The quantization unit **160** may be an additional example of the operation and/or structure of the quantitation unit **103** of FIG. **1**.

[0113] The quantized coefficient determining unit **161**, the rounding offset determining unit **162**, and the quantized coefficient arranging unit **163** may be operated in the substantially same manner as the aforementioned quantized coefficient determining unit **103***a*, rounding offset determining unit **103***b*, and quantized coefficient arranging unit **103***c*.

[0114] The internal memory **164** may store a lookup table, and the lookup table may store the predetermined or, alternatively, desired rounding offset value. That is, the rounding offset value corresponding to the aforementioned k value may be previously stored. If the number of cases that can be determined by the k value is limited, the data encoding speed can be improved by calculating the rounding offset value using the previously stored lookup table.

[0115] FIG. **9** is a flowchart sequentially showing a method of encoding data according to at least one example embodiment of the inventive concepts.

[0116] Referring to FIG. **9**, in the method of encoding data according to at least one example embodiment of the inventive concepts, first, first video data (VD**1**) is inputted in a macroblock unit (S**100**). Here, the first video data (VD**1**) may be data transformed into a frequency domain. That is, the first video data (VD**1**) may be a transformed coefficient (TC) frequency-transformed through the transform unit **102**. The macroblock unit may be, but is not limited to, a 4×4 pixel or a 16×16 pixel.